Williwaw Engineering

May 3, 2016

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Subject: April 2016 Monthly Report – RCUH P.O. #Z10115098

Dear Luis,

The following constitutes my monthly report for the subject agreement for services associated with April 2016.

Work Completed under Activity 1: "Provide technical and software support services to HNEI technical staff in programming data acquisition (DAS) controllers and analyzing data records in the following areas as assigned":

- Monitored the device regularly via remote connection to the NWEI host PC in Room 106, Battery French. Downloaded data from PC as necessary, and updated device control settings when necessary.

- Analyzed power data to produce monthly power performance data plots; see Attachment 1 for results.

- Analyzed Azura float angle data using MATLAB to produce a plot of 30 minute average float angle data for the deployment period. The Azura hull ballast has continued to be stable since the beginning of 2016.

- Plotted daily humidity sensor data for the cRIO controller enclosure and drybox on board the Azura. The drybox, which is entirely sealed from the Azura hull, has maintained humidity less than 10% throughout the deployment period while humidity inside the cRIO enclosure continues to stabilize at less than 30%. See Attachment 3 for a plots of these results.

- Completed an interim test report covering Azura testing for the period June 2015 – March 2016. This report was submitted separately to HNEI earlier in the month.

Please let me know if you have any questions or comments concerning this project.

Sincerely,

Terry Lettenmaier

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email: lett@peak.org

Attachment 1: Azura power performance data plots

Attachment 2: Azura 30 minute average float angle data plots

Attachment 3: Azura cRIO enclosure and drybox humidity

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Attachment 1

Azura power performance data plots

Azura Power Performance – April 2016

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Summary

- Azura power performance was calculated and is presented as described in IEC Technical Specification 62600-100.
- Device performance is presented per IEC 62600-100 using capture length and normalized power matrices. Normalized power was calculated from capture length and energy flux of representative spectra for each H_{m0}-T_e bin.
- Average power matrices, 95th percentile power matrices, and percent difference between normalized power and average power are also presented.
- The representative spectra for IEC 62600-100 calculations were calculated by taking the average of all spectra recorded for each bin, then shifting the magnitude and frequency of the average spectra so that their H_{m0} and T_e are at the center of each bin.
- Plots of April 2016 data only are shown on Slides 3-11
- Plots of cumulative data for the entire deployment period January-April 2016 are shown on Slides 13-21
- Azura was operated (output connected to grid) for 711 hours in April (98.6% of month). Most of the down time was during temporary shut downs until the device controller was manually reset after brief grid voltage interruptions.
- Device control was continued through all of April in constant hydraulic motor displacement mode, with the settings cycled between six different settings. This is the simplest control method possible for the Azura.

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Azura Power Performance
Monthly Data April 2016

Azura Power Performance – April 2016

Data samples collected

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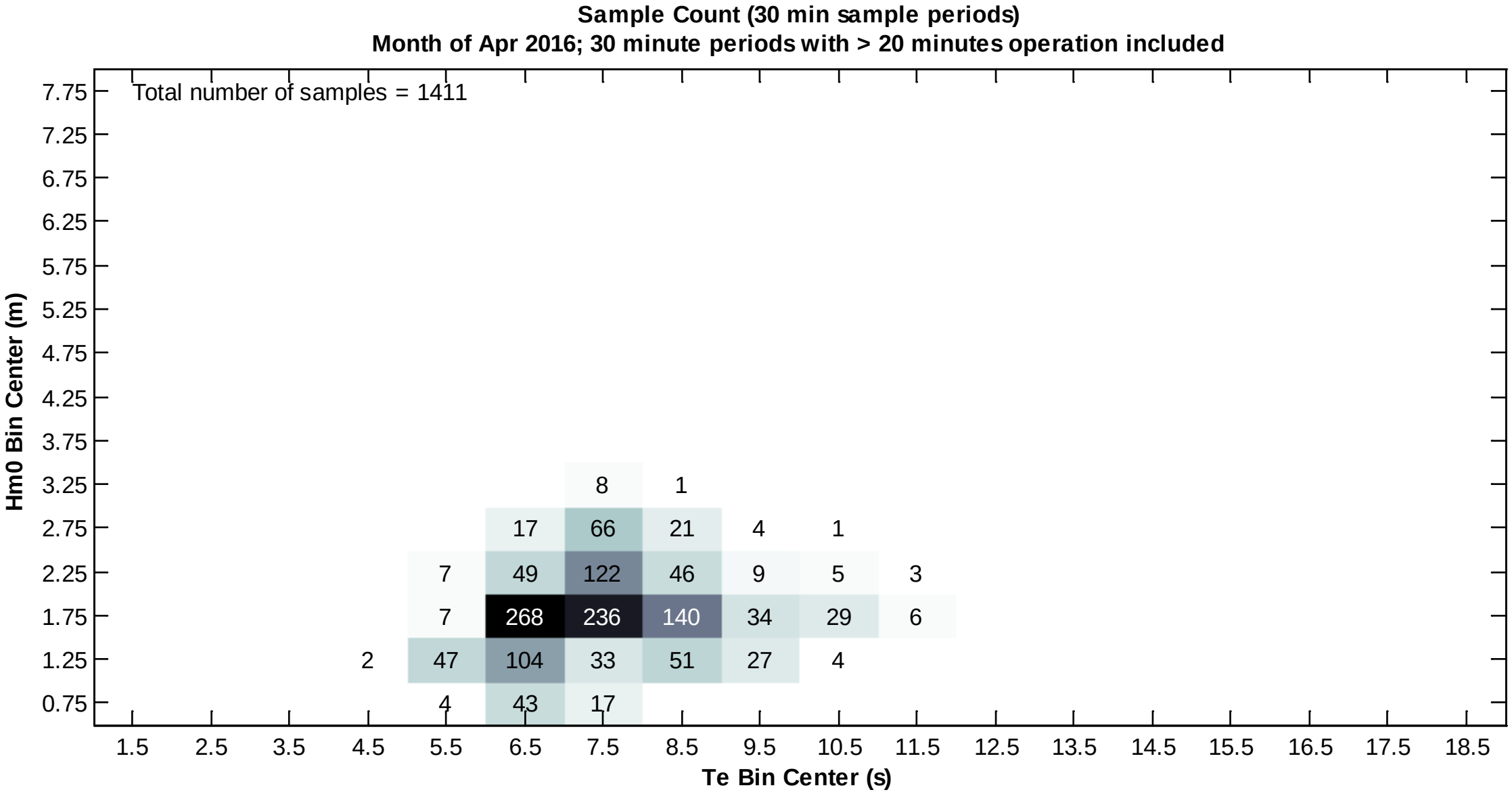

Azura Power Performance – April 2016

Mean capture length matrix

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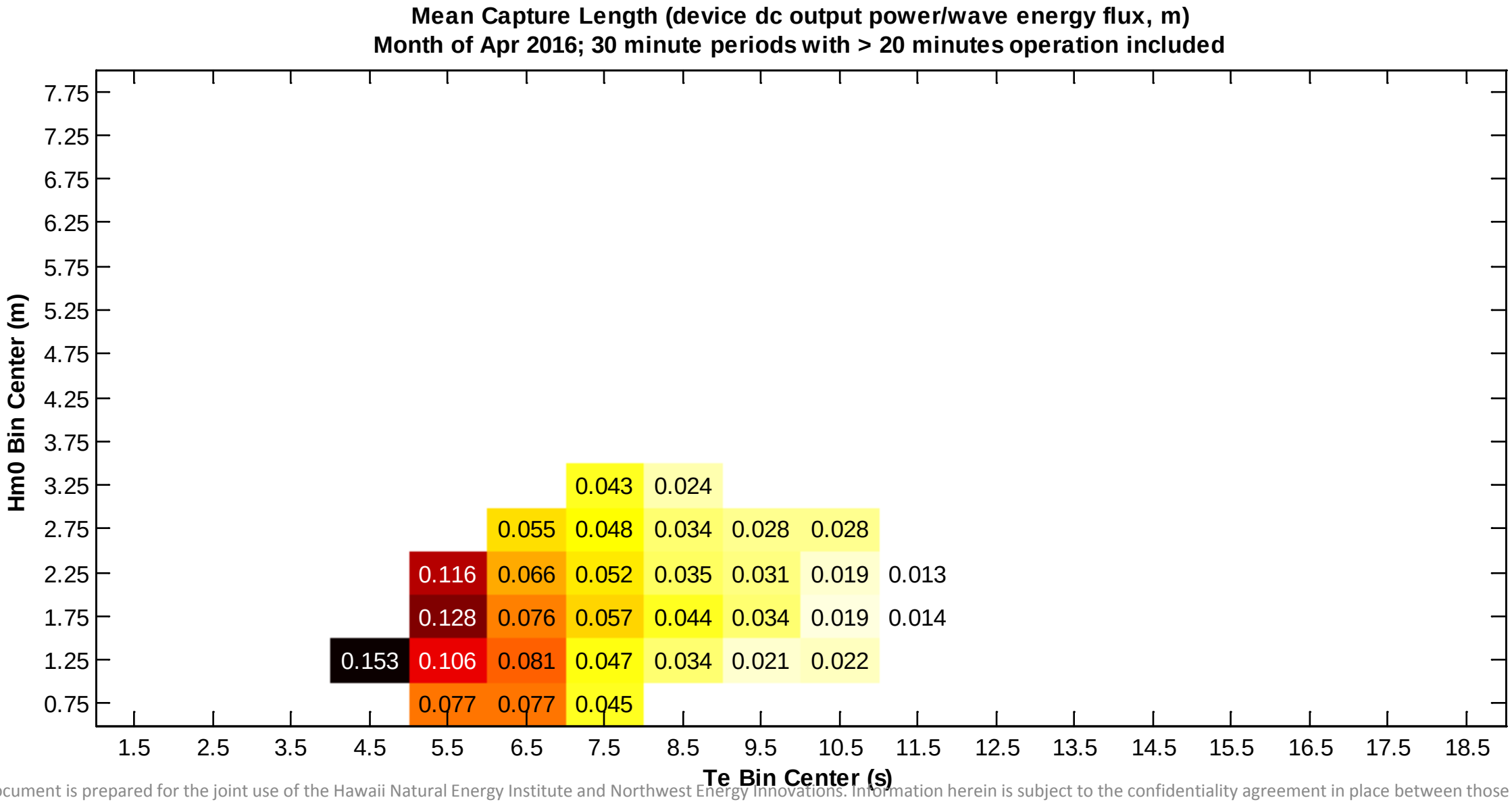

Azura Power Performance – April 2016

Standard deviation of capture length

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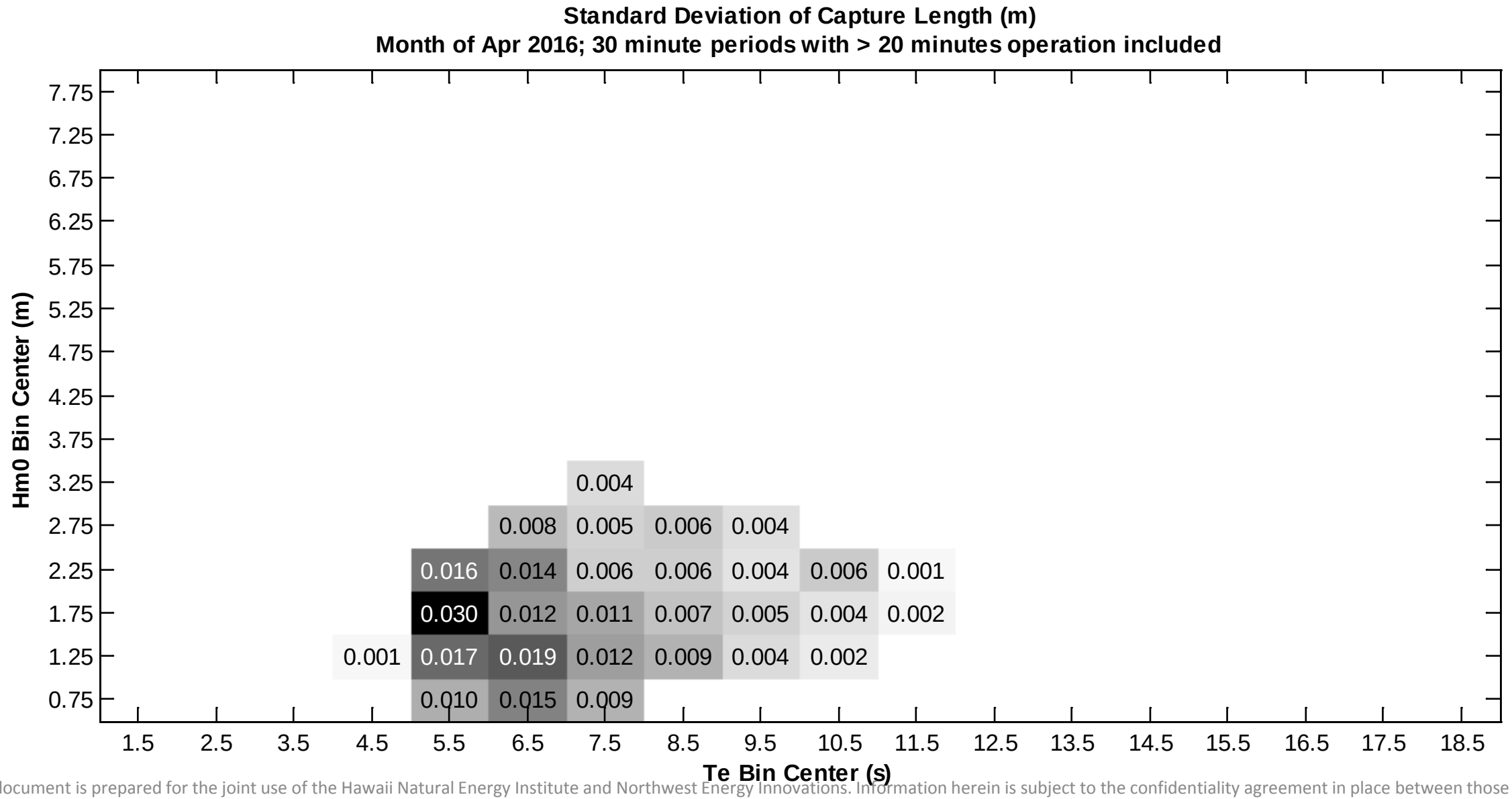

Azura Power Performance – April 2016

Maximum capture length matrix

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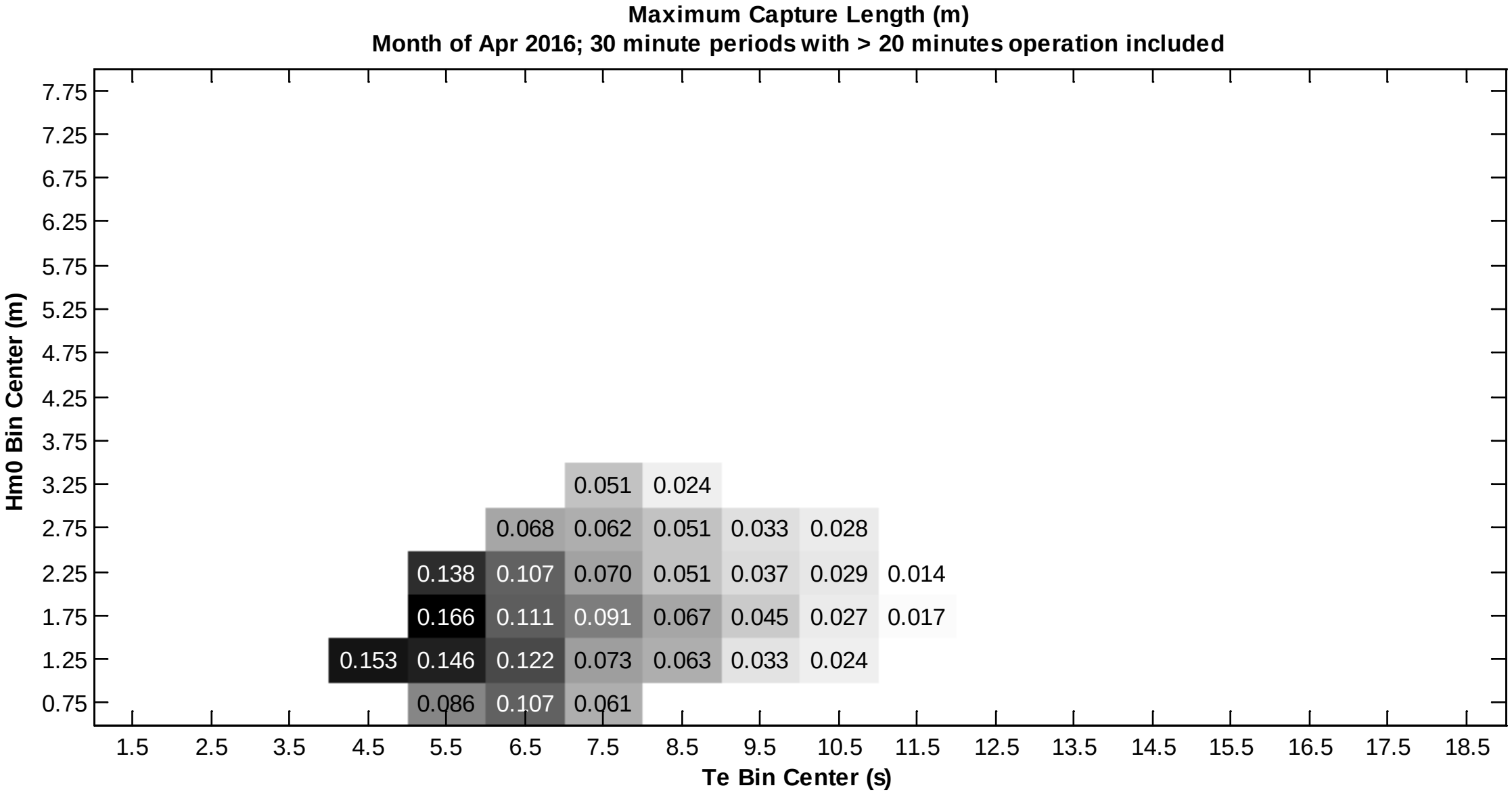

Azura Power Performance – April 2016

Minimum capture length matrix

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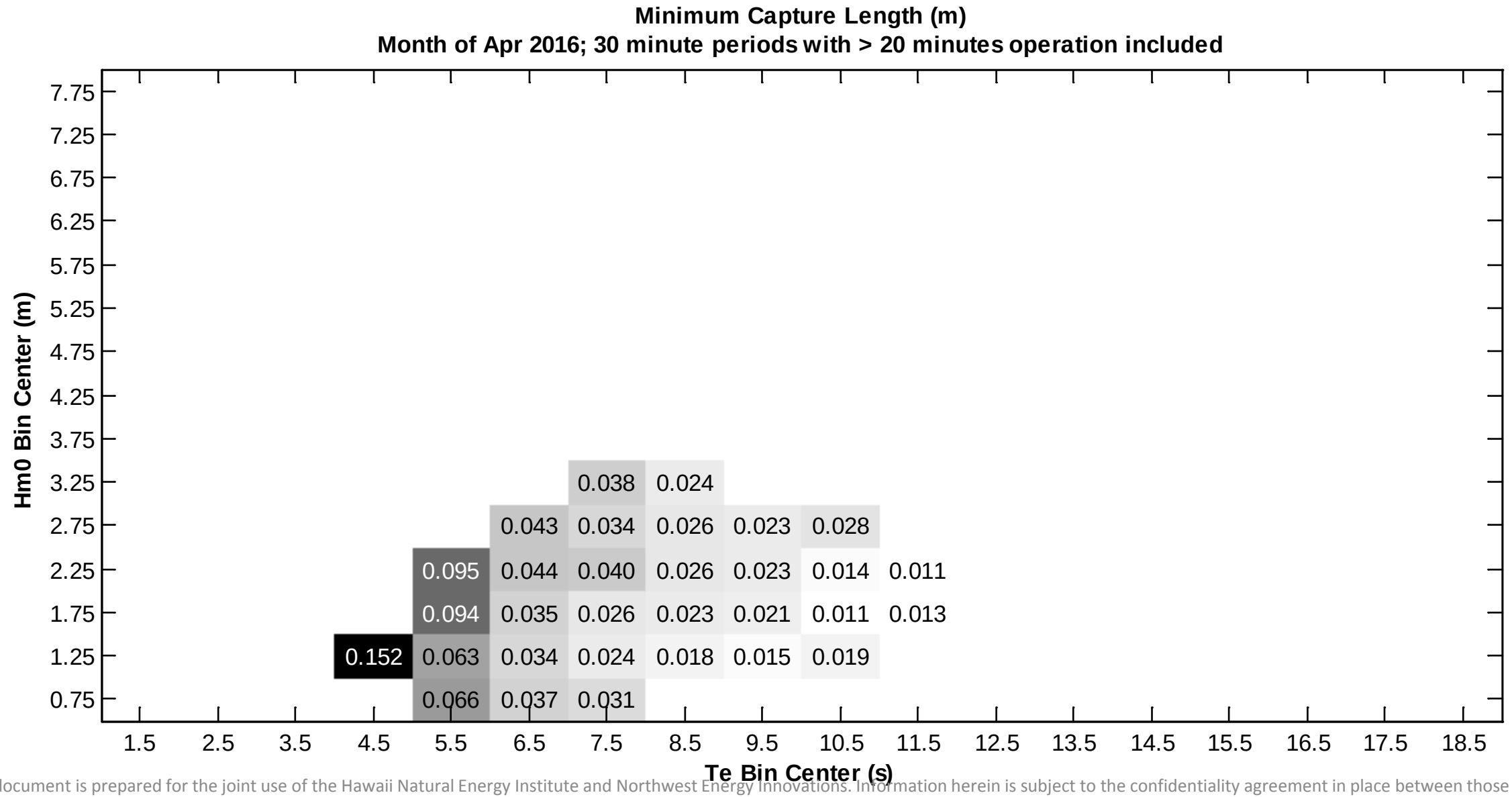

Azura Power Performance – April 2016

Normalized power matrix

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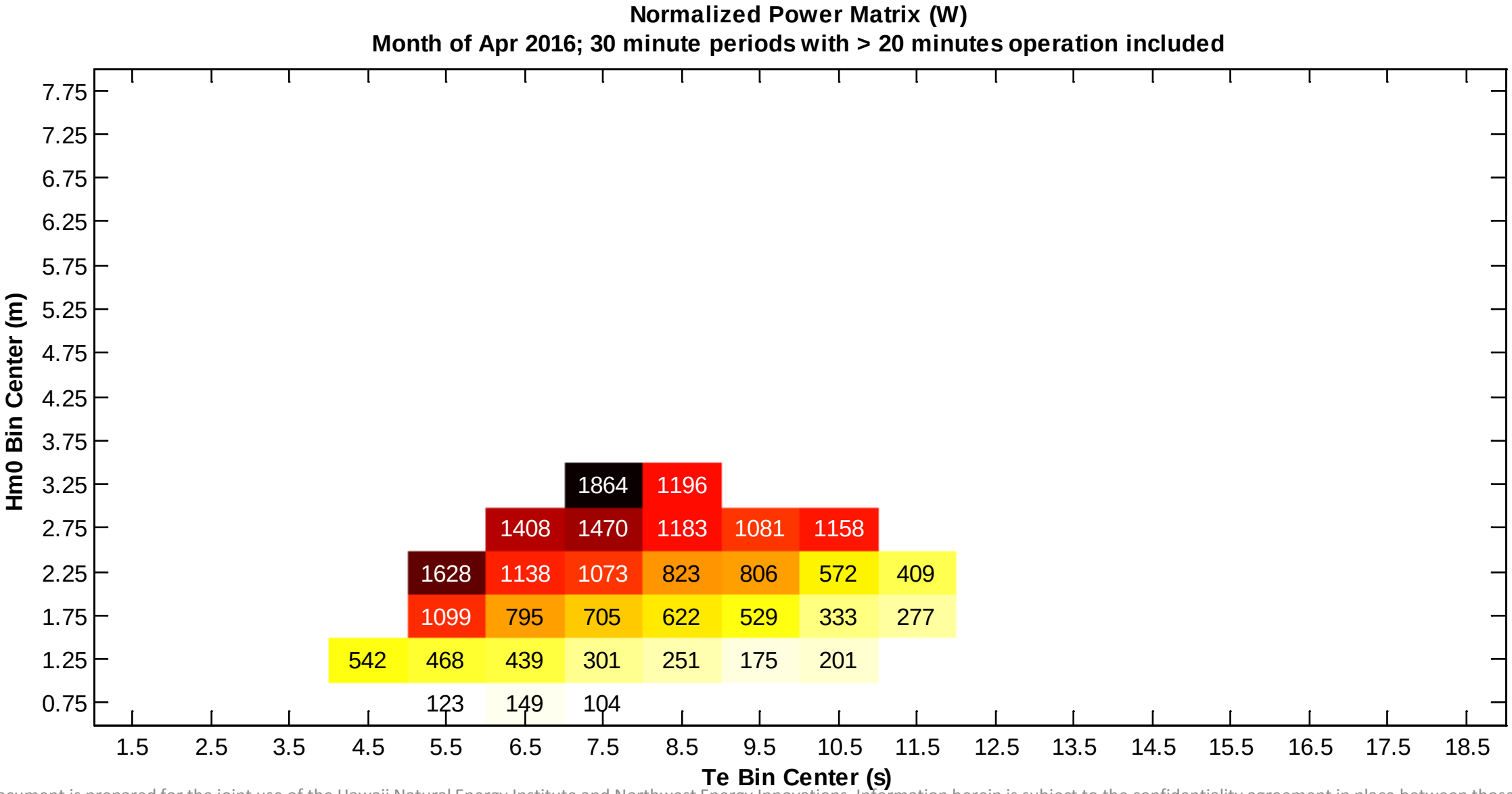

Azura Power Performance – April 2016

Mean power matrix

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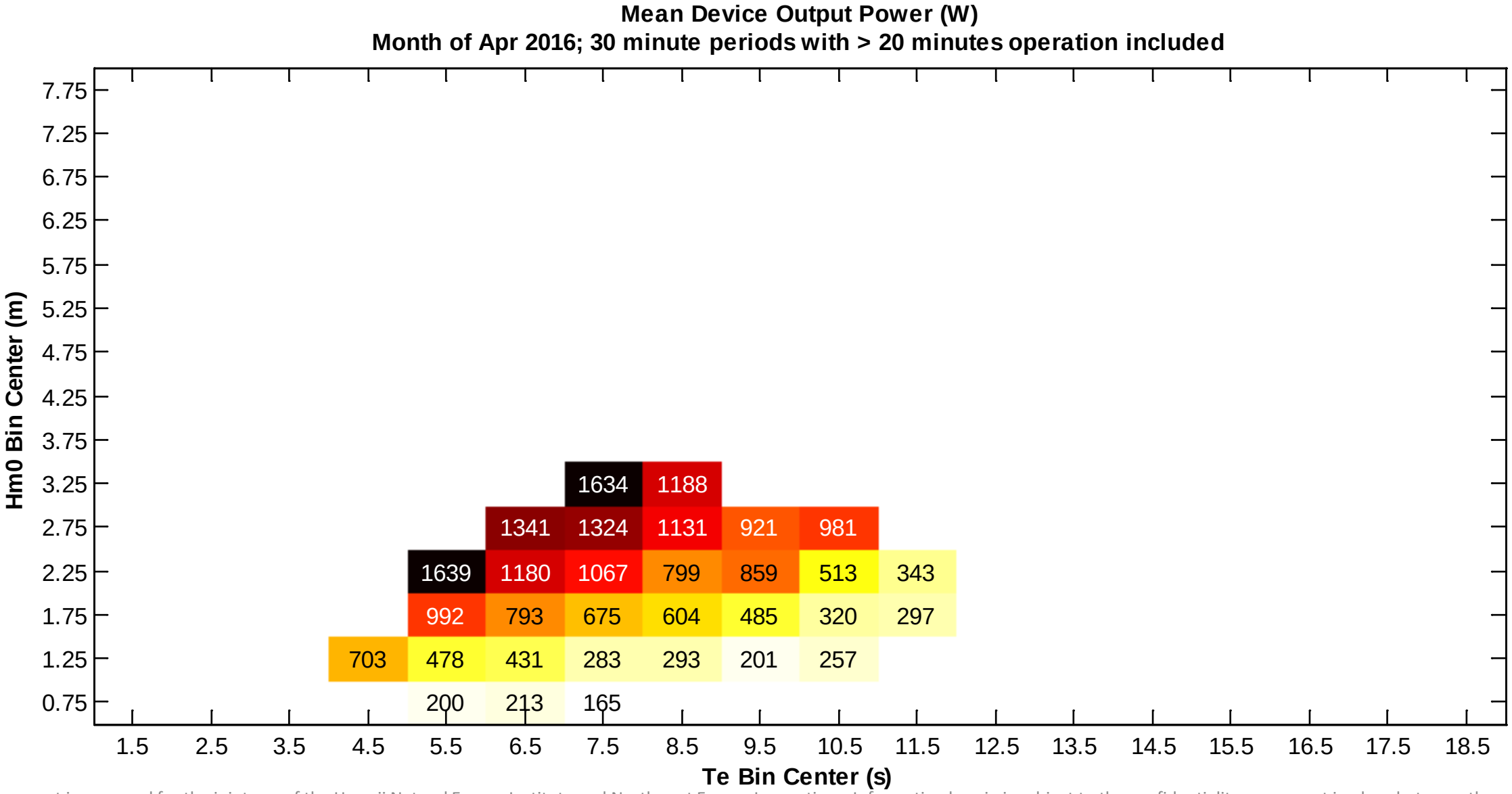

Azura Power Performance – April 2016

Percent difference between normalized and mean power matrix

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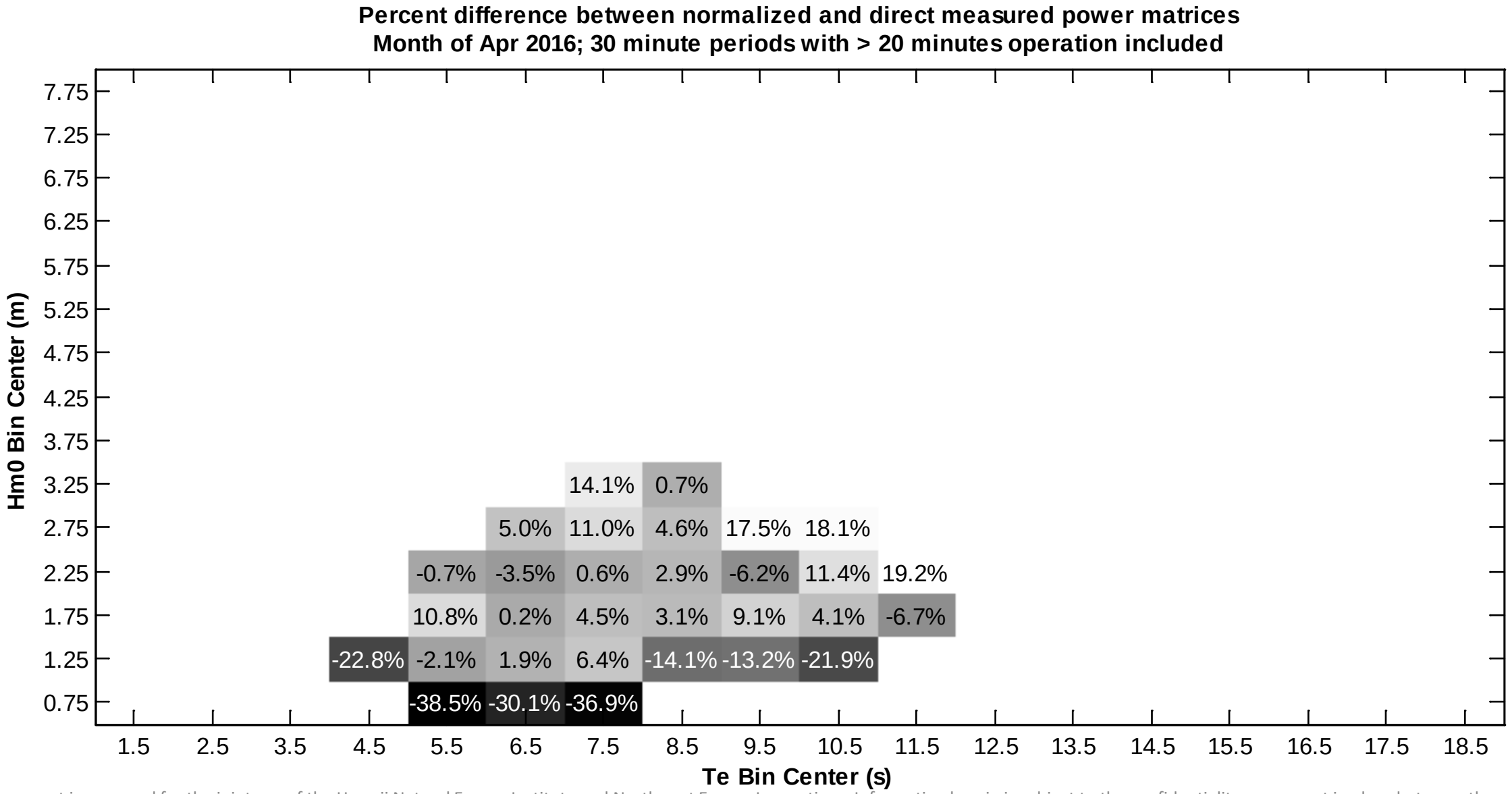

Azura Power Performance – April 2016

95th percentile power matrix

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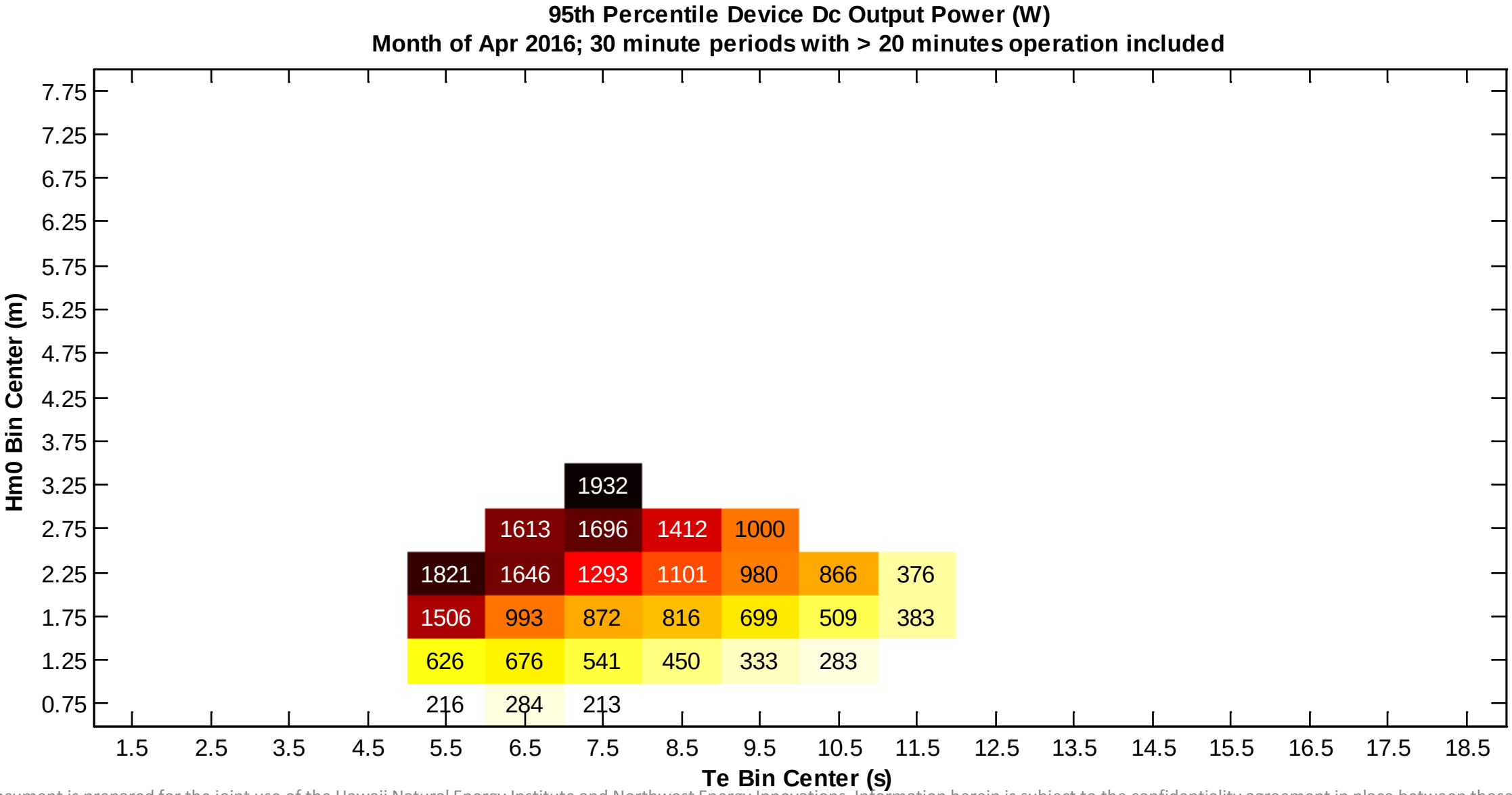

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Azura Power Performance
Cumulative Data January – April 2016

Azura Power Performance – Jan-April 2016

Data samples collected

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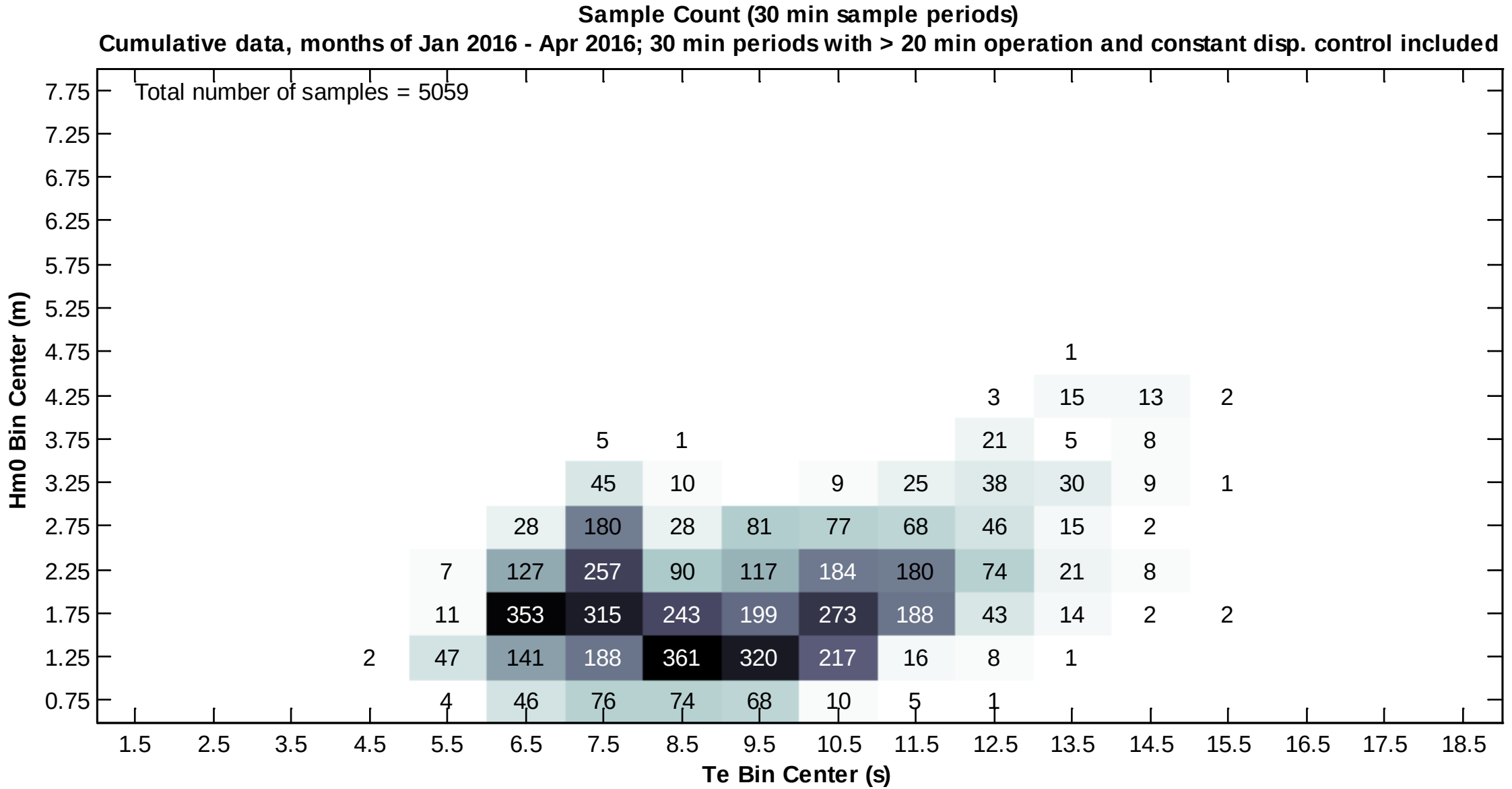

Azura Power Performance – Jan-April 2016

Mean capture length matrix

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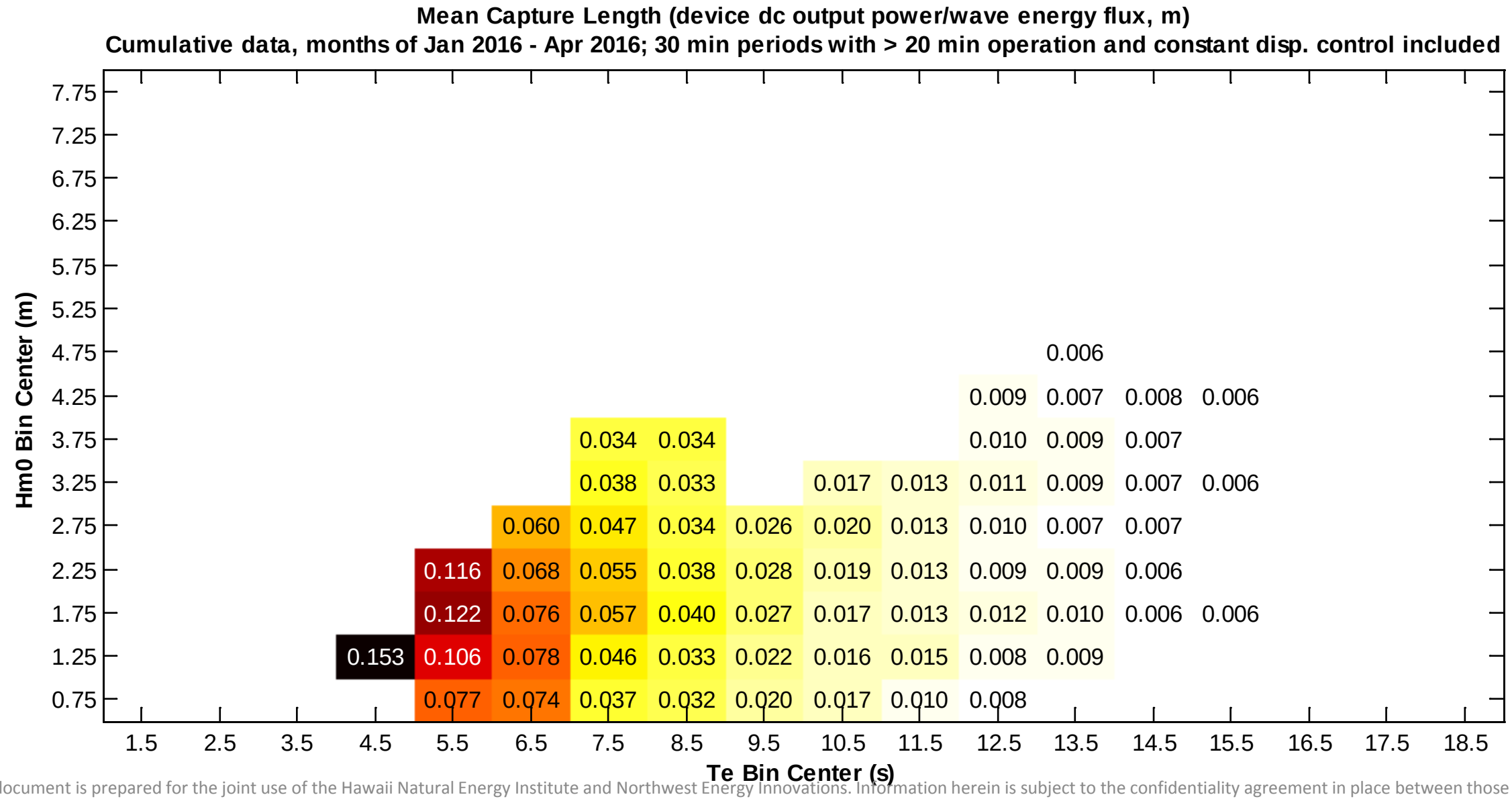

Azura Power Performance – Jan-April 2016

Standard deviation of capture length

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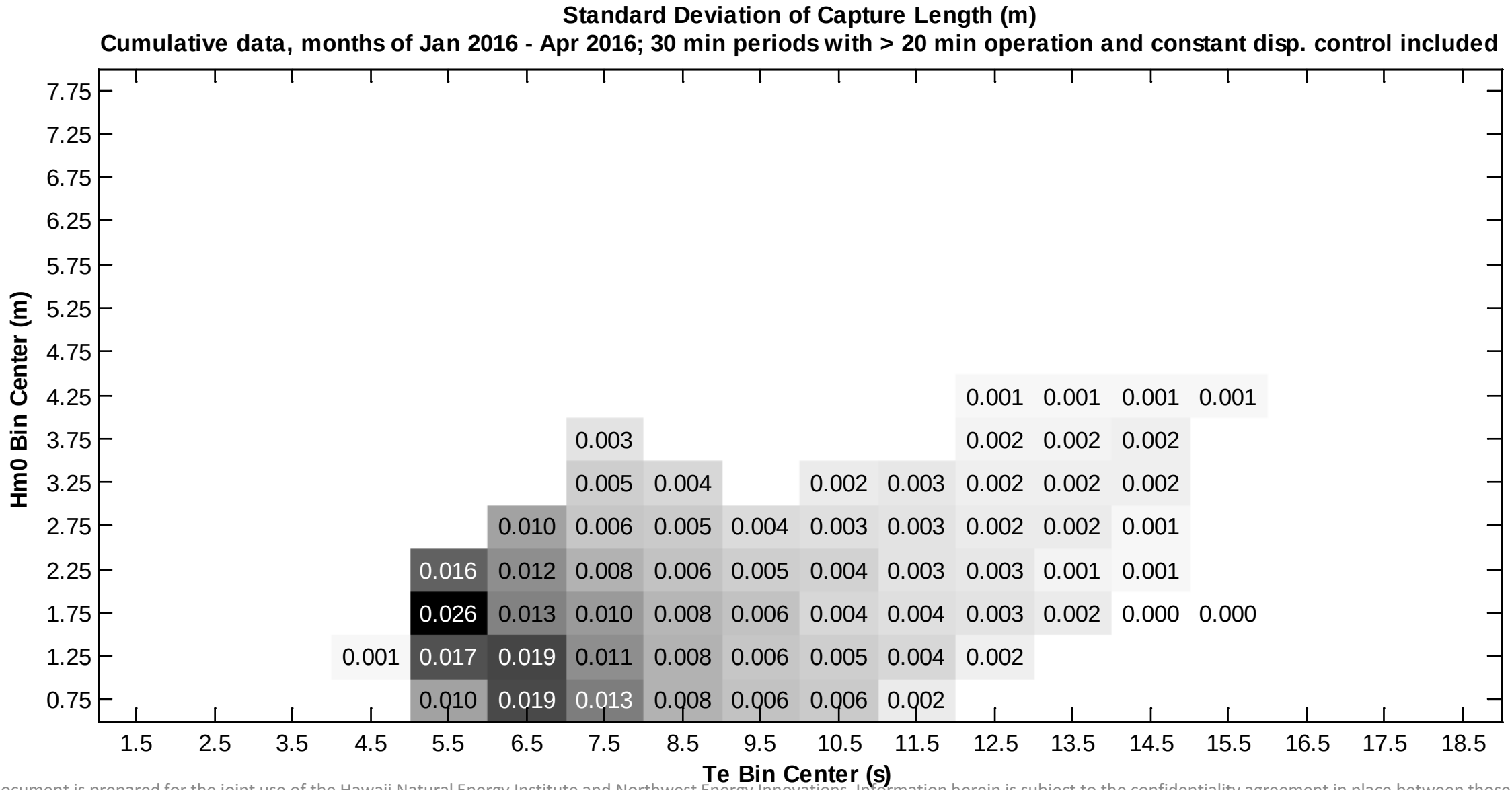

Azura Power Performance – Jan-April 2016

Maximum capture length matrix

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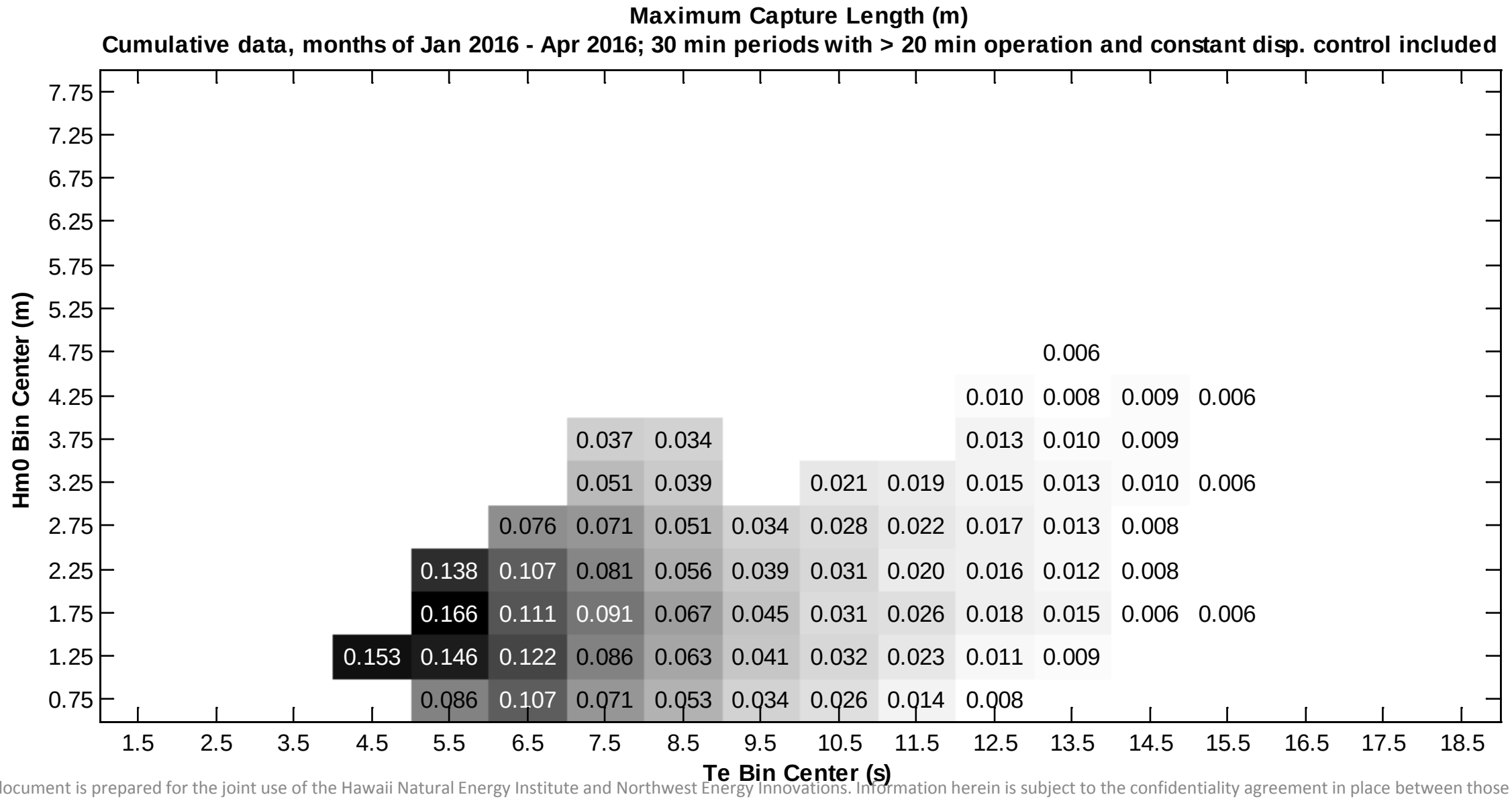

Azura Power Performance – Jan-April 2016

Minimum capture length matrix

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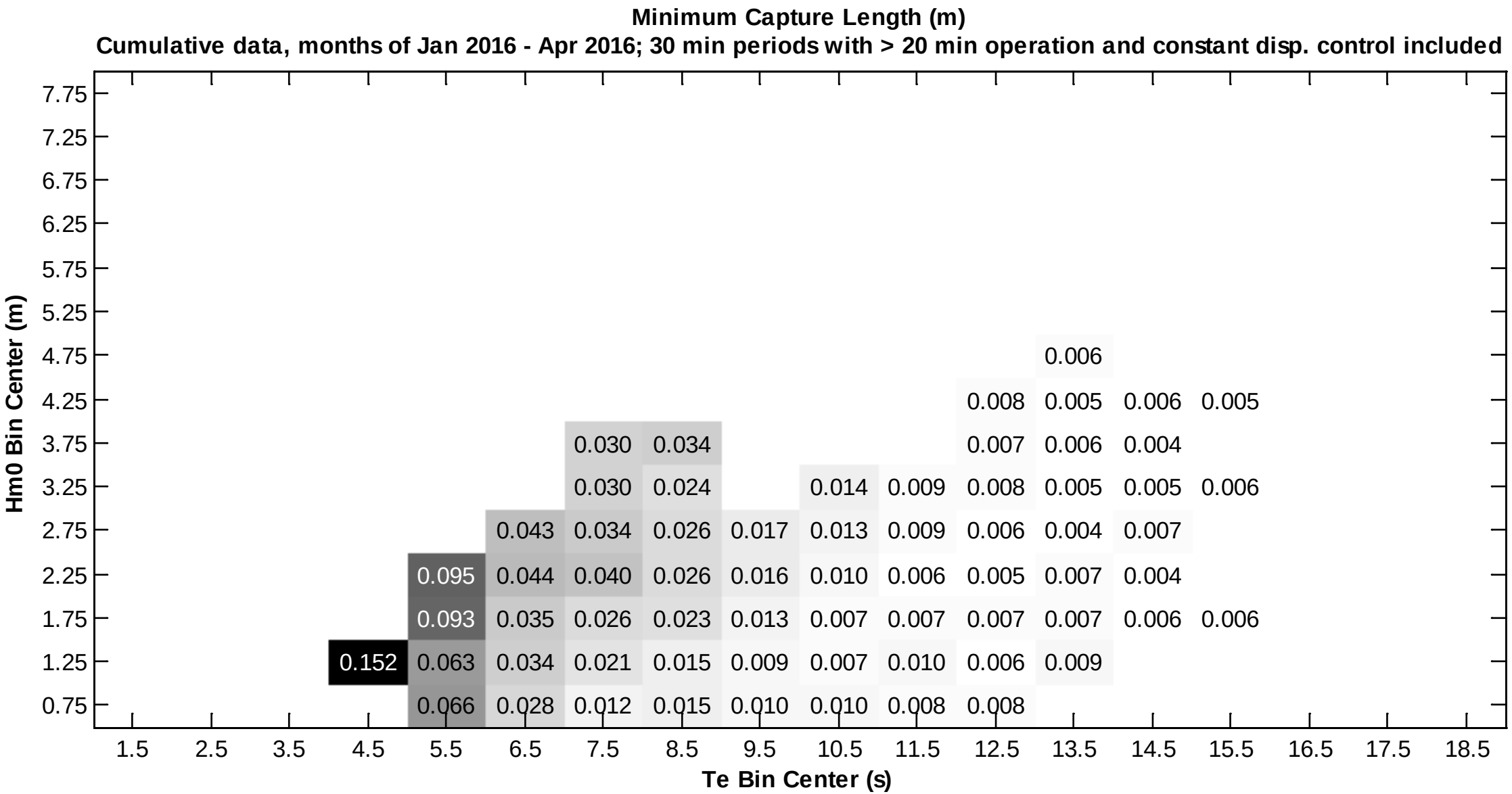

Azura Power Performance – Jan-April 2016

Normalized power matrix

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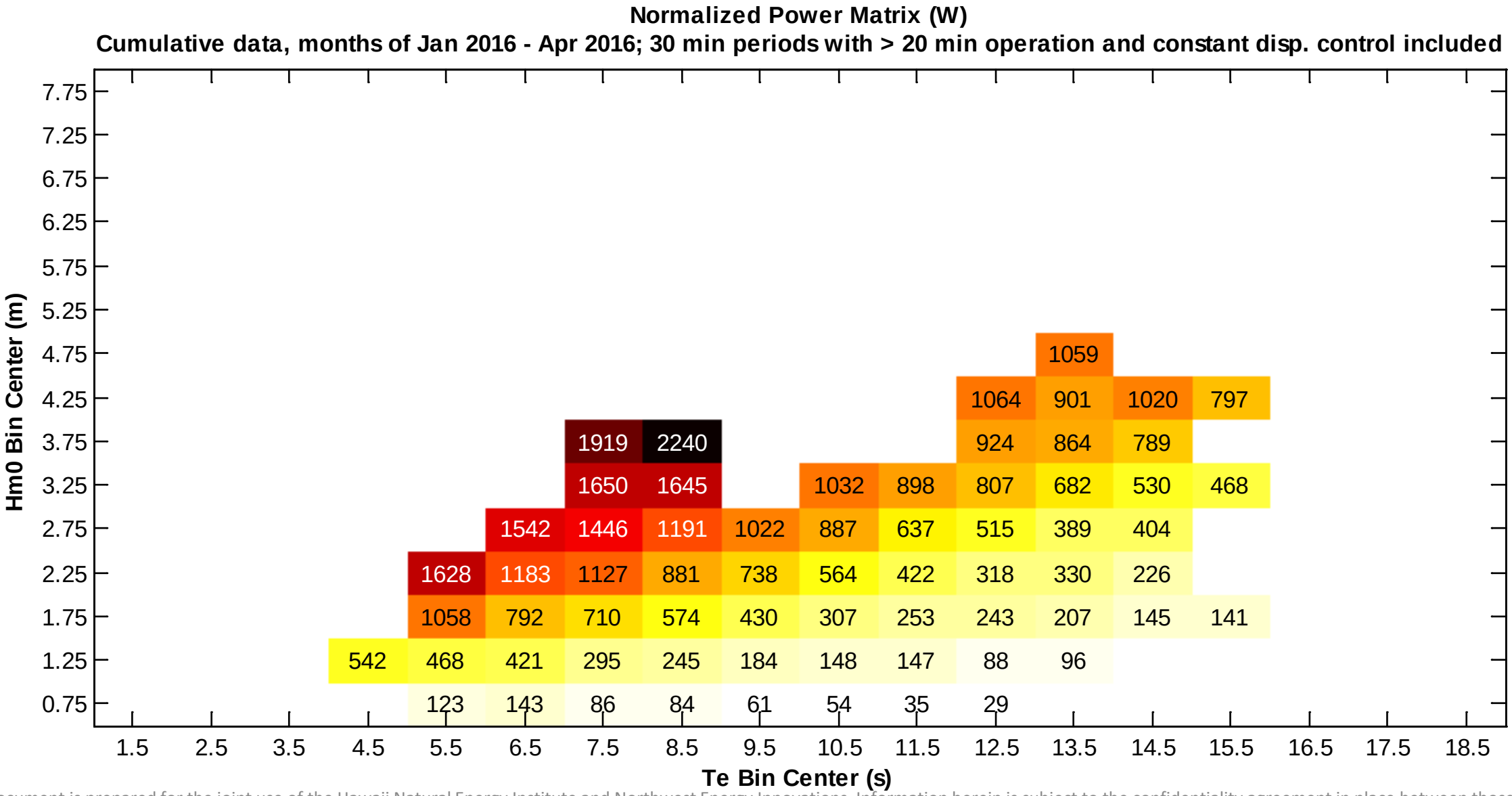

Azura Power Performance – Jan-April 2016

Mean power matrix

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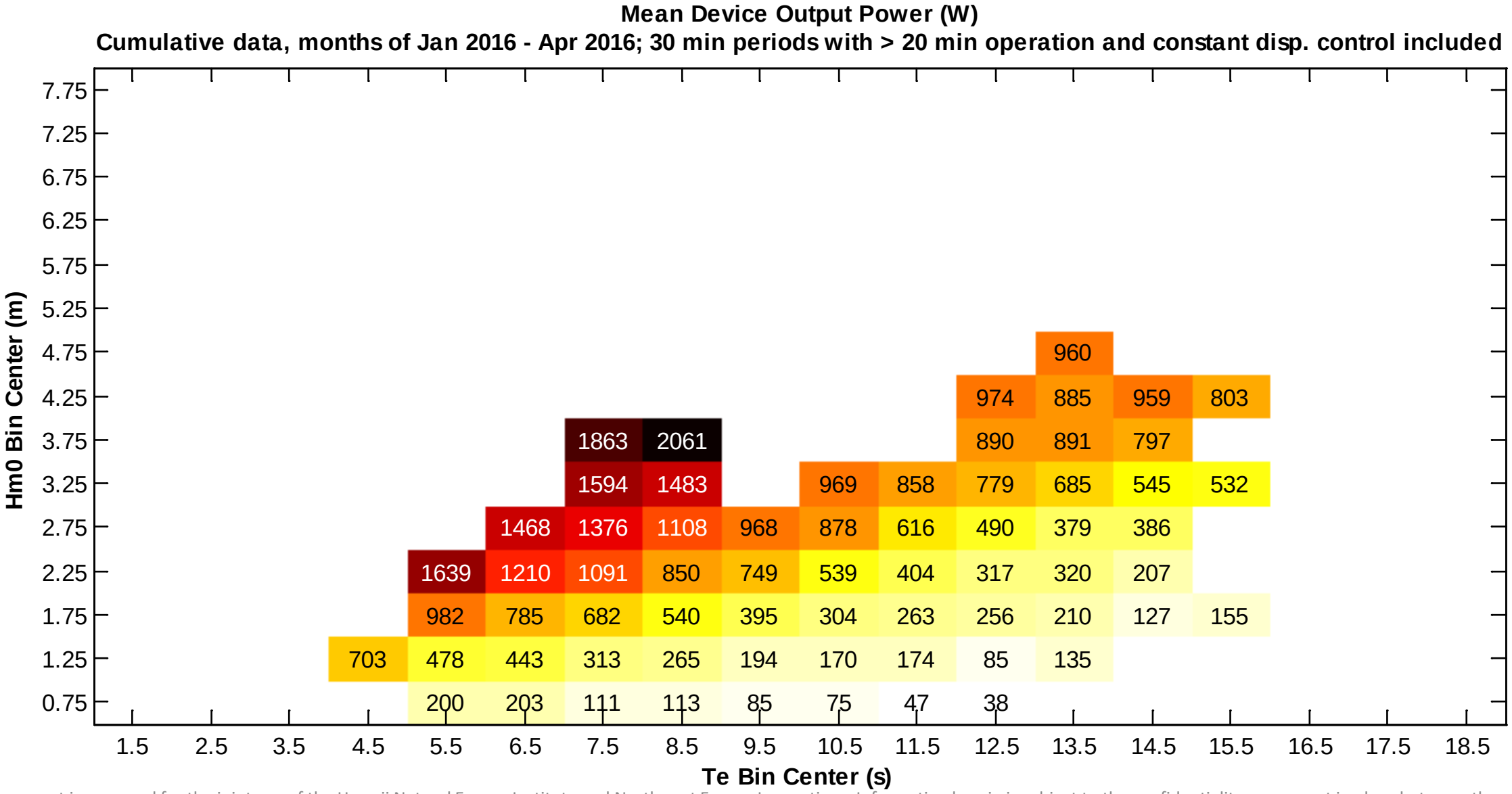

Azura Power Performance – Jan-April 2016

Percent difference between normalized and mean power matrix

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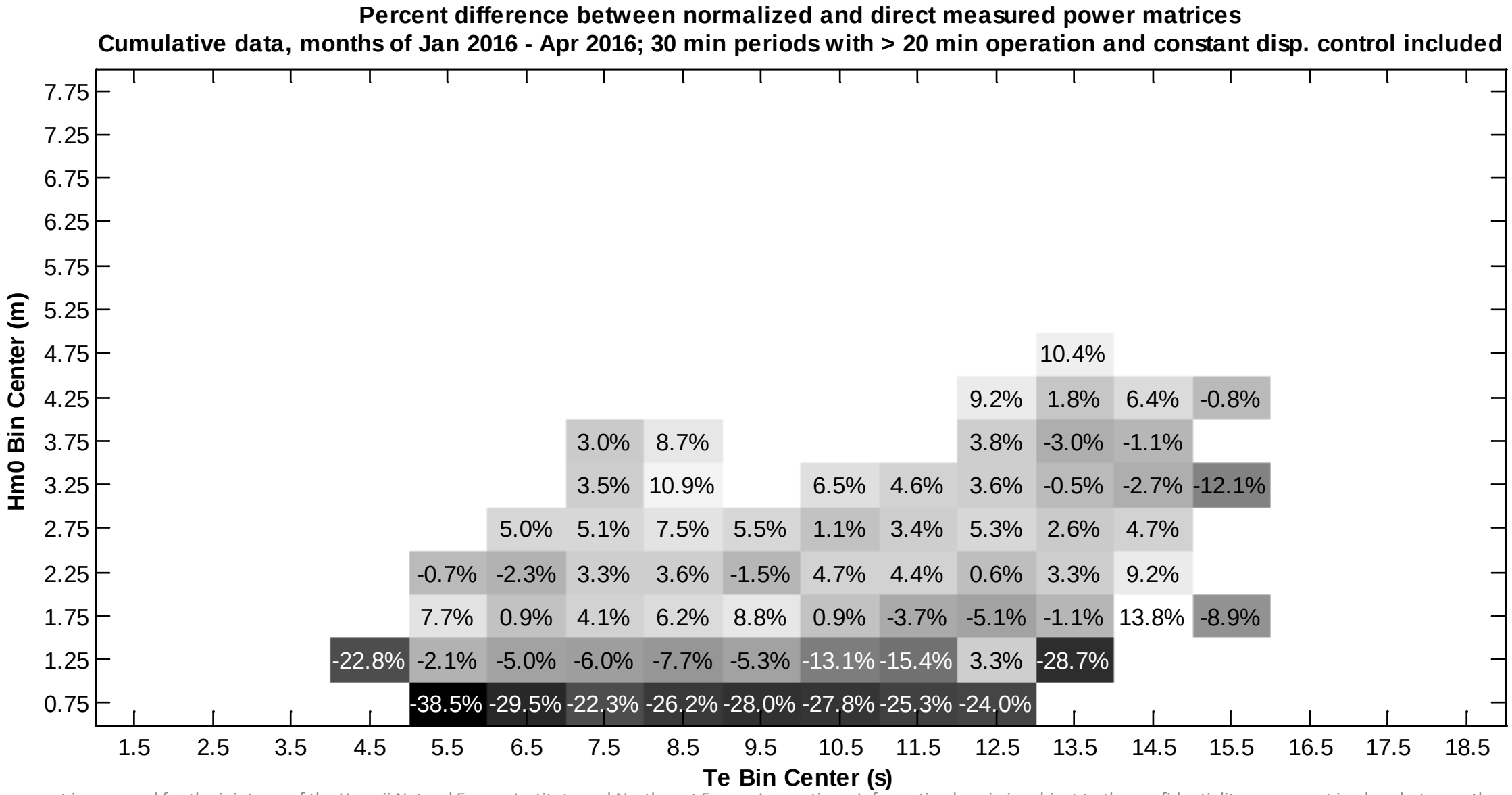

Azura Power Performance – Jan-April 2016

95th percentile power matrix

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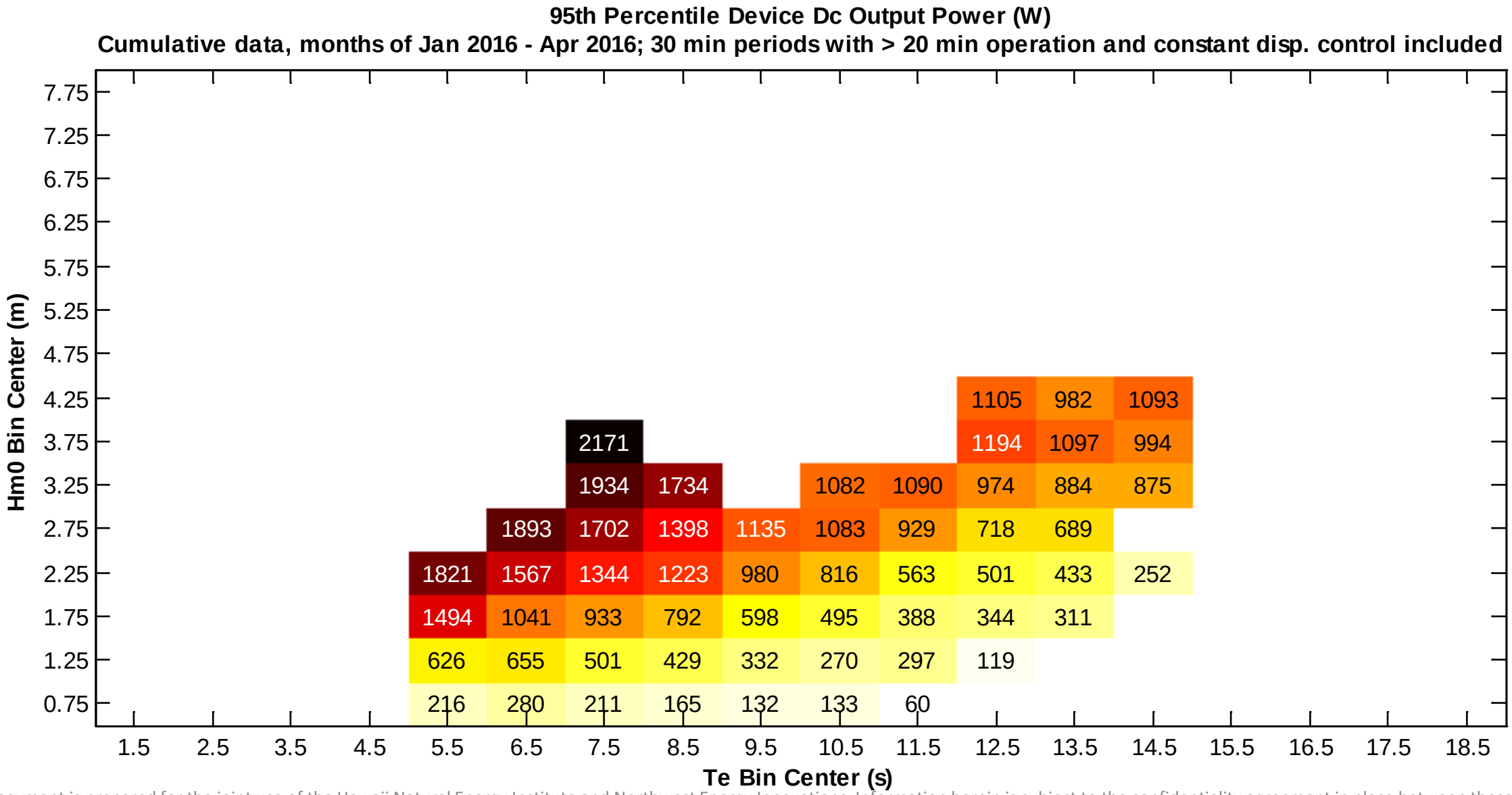

Attachment 2

Azura 30 minute average float angle data plots

Azura 30 minute average float angle data – April 2016

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Summary

- See Slide 2 for plot of June 2015 – April 2016 data
- Average float angle has been steady near zero angle since the AB subsurface float was re-installed on January 9.
- Angle sensor 1 failed on April 14 (reason unknown). This is a 0-360 degree sensor.
- Since Sensor 2 has a 0-180 degree range, it can not indicate what side of the device the float is on. However, video observation of the Azura has shown that the float has been offshore during the last part of April.

Azura 30 min average float angle data through April 2016

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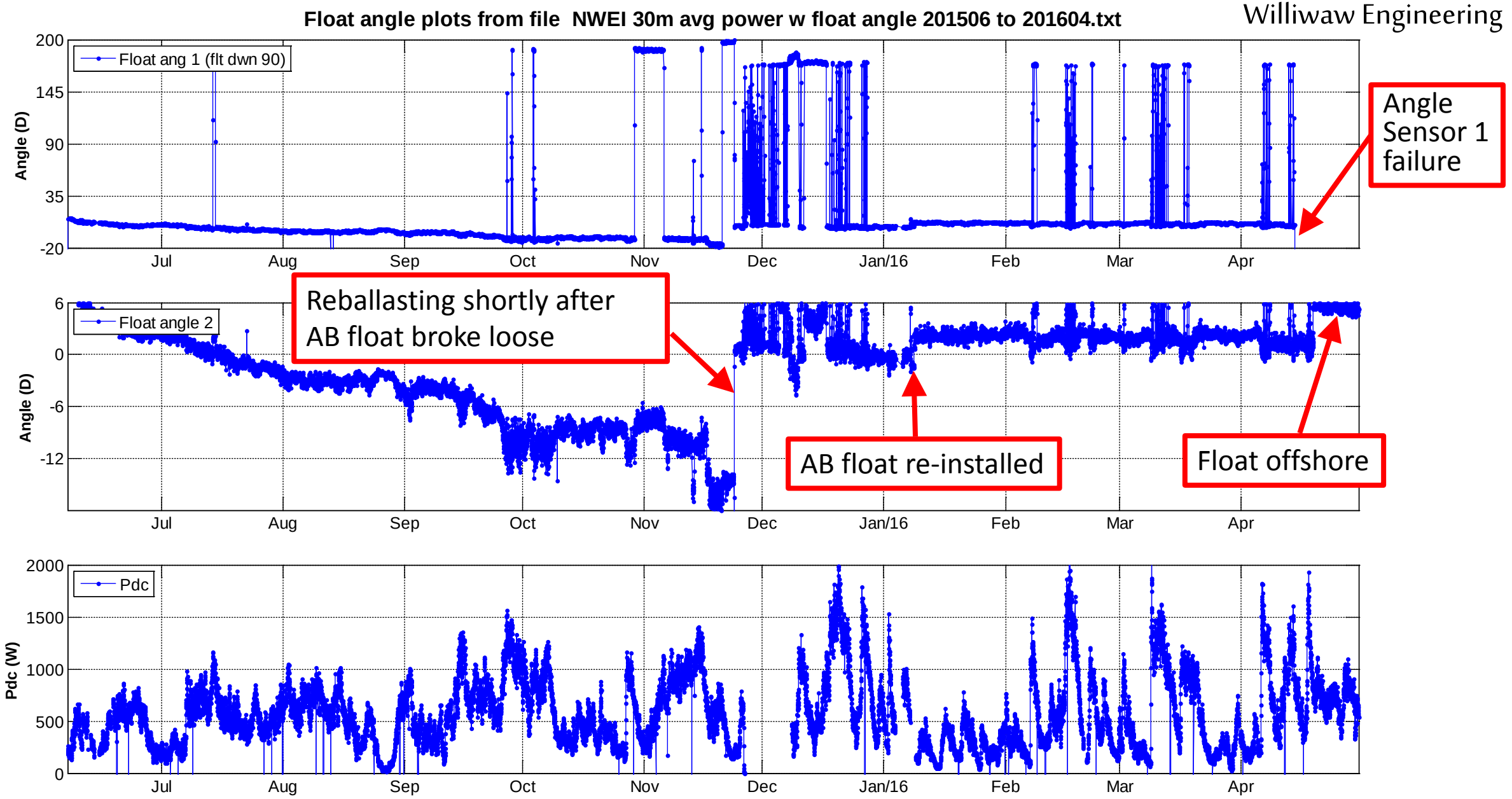

Attachment 3

Azura cRIO enclosure and drybox humidity plots

Azura cRIO enclosure and drybox humidity April 2016

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